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(54) Optical disk recording device

Aufzeichnungsvorrichtung für optische Platte

Dispositif d'enregistrement de disque optique

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(56) References cited:
EP-A- 0 420 250
EP-A- 0 422 227
DE-A- 3 644 313
US-A- 4 206 477
US-A- 4 937 809
US-A- 5 170 382
US-A- 5 177 727

- PATENT ABSTRACTS OF JAPAN vol. 16, no. 163 (P-1341) 21 April 1992 & JP-A-04 011 334 (RICOH CO LTD) 16 January 1992

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Description

[0001] This invention relates to an optical disk recording device of a type which records information by projecting laser beam on a recording surface of an optical disk to form pits thereon and, more particularly, to an optical disk recording device of this type capable of preventing occurrence of an adverse effect to signal-to-noise ratio of a wobble signal when recording is made by using a higher recording speed than a normal recording speed.

[0002] As a manner of recording information on a write-once type optical disk on the basis of the CD-WO (CD Write Once) standard, it has been proposed to record information by using not only a normal speed but also a higher speed than the normal speed such as a double speed and a quadruple speed. By using such high speed recording, for example a quadruple speed, it is possible to store data such as CD-ROM data and audio data in a hard disk, read the stored data in the form of quadruple compressed data, and record the read out data by driving an optical disk at a quadruple speed. In case a double speed is employed, for example, a Compact Disc player may be driven at a double speed and an optical disk may be driven at a double speed also to copy reproduced data.

[0003] In a prior art optical disk recording device, it has been proposed to perform a high speed recording by increasing power (pit power) of recording laser beam in a pit forming section (i.e., pit period) as shown in Fig. 2 for accurately forming pits on the optical disk.

[0004] According to the CD-WO standard, a groove called "pregroove" is preformed on the recording surface of an optical disk and, during recording of information, recording is made by tracking this pregroove under a tracking control. This pregroove is not a straight line but is undulated with a particular frequency and this undulation is called "wobble". In the recording mode, this wobble is detected on the basis of a residual component of a tracking error signal and a CLV (constant linear velocity) spindle control is realized by PLL-controlling a disk motor so that the frequency of the detected wobble will become a predetermined frequency (e.g., 22.05 kHz in a normal recording speed mode).

[0005] If the device is designed in a manner to detect a tracking error constantly, a DC offset component of a tracking error signal will increase and a signal-to-noise ratio will be deteriorated due to influence caused by a signal at a pit position and this will cause an adverse effect on the tracking control and the spindle control based on the wobble signal and will also make it difficult to obtain ATip information (time information) contained in the wobble signal. Therefore, in a bottom period in which a pit is not formed, an attempt has been made to detect a tracking error in only a bottom period in which laser beam of a low power (bottom power) which is insufficient for forming a pit is projected (Fig. 2) and hold a tracking error signal of an immediately preceding value in a pit period.

[0006] For detecting a tracking error only in the bottom period, it is necessary, for obtaining a wobble signal of an adequate signal-to-noise ratio, to make as much time as possible in the bottom period available for detection of a tracking error signal. It is therefore desirable to make the whole bottom period available but, actually, as shown in Fig. 3B, the waveform of reflected beam from a disk has a delayed trailing edge as compared with a laser diode output shown in Fig. 3A and this causes leakage (a shaded portion in Fig. 3B) of a signal in the pit period to a bottom period. A frequency range of this leakage signal portion extends over a frequency range of the wobble signal as well as a frequency range of an EFM signal. Therefore, when a tracking error is detected throughout the entire bottom period, the signal-to-noise ratio of the wobble signal is deteriorated rather than it is improved.

[0007] Since the trailing edge of the waveform of the reflected beam from the disk assumes an exponential curve, it is necessary to determine a fall period Δt in such a manner that the trailing edge is decayed to such an extent that influence of the signal in the pit period is reduced and an adequate length of a tracking error signal detection period can be made available and to perform detection of a tracking error during the bottom period excluding this fall period Δt. In this case, the fall period Δt is determined at a length at which the best signal-to-noise ratio of the wobble signal is available by minimizing the influence of the signal in the pit period and maximizing the tracking error detection period.

[0008] The value of the fall period Δt thus determined is relatively small when the recording speed is a normal (one time) speed but, when the recording speed becomes higher than the normal speed, a relatively long fall period Δt is required as shown in Fig. 3C because it takes more time for the waveform of the reflected beam to decay completely. This results in shortening of the tracking error detection period with resulting deterioration of the signal-to-noise ratio of the wobble signal.

[0009] Further information relating to the prior art can be found in US-A-5 170 382 and DE-A-36 44 313.

[0010] DE-A-36 44 313 relates to a recording and reproduction apparatus for optical information with a single semi-conductor laser for recording information bits on an optical recording film in the writing mode with laser light that depends on a driving current modulated by an information signal and for radiating a constant reading laser light onto the recording film in reading mode in order to reproduce signals recorded on the recording film.

[0011] US-A-5 170 382 discloses a magneto optical apparatus for recording an information signal on a disk by illuminating a magnetic layer on a disk with a pulsed laser beam and applying a magnetic field with a polarity switched according to the information signal to the spot illuminated by the laser beam. Said apparatus compris-

ing means for controling the peak power level as well as the bottom power level of the laser beam depending on the radius at which the data is recorded.

[0012] It is, therefore, an object of the invention to provide an optical disk recording device capable of preventing occurrence of deterioration of signal-to-noise ratio of a wobble signal when the recording speed is changed.

[0013] For achieving the above described object of the invention, according to the invention, not only a pit power of recording laser beam but also a bottom power of recording laser beam is increased as a recording speed increase ratio is increased.

[0014] For this purpose, an optical disk recording device according to claim 1 is provided.

[0015] According to the invention, in a case where recording is made at a higher recording speed, not only the pit power but also the bottom power of the recording laser beam is increased and, accordingly, difference between the pit power and the bottom power is reduced as compared with a case where the pit power only is increased. As a result, time required for the waveform of the reflected beam to fall is reduced and an adequate time is made available for detection of a tracking error, so that deterioration of the signal-to-noise ratio of the wobble signal can be prevented.

[0016] Further, since recording is made at a higher recording speed increase ratio, an erroneous forming of a pit can be prevented in spite of the increased bottom power.

[0017] Furthermore, according to the invention, the increase in the bottom power enables the leading edge of a pit power of a next pit period to become sharp and thereby reduces an error in the start position of pit forming.

[0018] Preferred embodiments of the invention will be described below with reference to the accompanying drawings.

In the accompanying drawings,

[0019]

Fig. 1 is a block diagram showing functions of a main portion of an embodiment of an optical disk recording device according to the invention shown in Fig. 4;

Fig. 2 is a waveform diagram showing a laser power control according to a prior art optical disk recording device;

Figs. 3A to 3D are waveform diagrams showing change in reflected laser beam waveforms according to the control of Fig. 2;

Fig. 4 is a block diagram showing an entire structure of an optical disk recording and reproducing device incorporating an embodiment of the invention;

Fig. 5 is a circuit diagram showing an example each of a tracking error detection circuit 31 and a sample hold circuit 33 shown in Fig. 1;

Fig. 6 is a circuit diagram showing an example of a laser power control circuit 25 of Fig. 1;

Figs. 7A to 7C are waveform diagrams showing an example of a laser power control by the circuit of Fig. 6; and

Fig. 8 is a circuit diagram showing a specific example of the circuit of Fig. 6.

[0020] An embodiment of the invention will now be described. In this embodiment, information is recorded on a write-once type disk of a dye system with the CD-WO standard and a recording speed is variable between one time speed (x1), i.e., normal speed, a double speed (x2) and a quadruple speed (x4). Fig. 4 shows the entire structure of an optical disk recording and reproducing device to which this invention is applied. In an input section 28, a recording speed increase ratio is set by a manual operation by an operator or other means. A disk servo circuit 16 controls rotation of a disk motor at a constant linear velocity and at the set recording speed increase ratio in response to a command from a system controller 19.

[0021] A focus servo and tracking servo circuit 18 controls, in response to a command from the system controller 19, a focus and a tracking of laser beam 11 projected from a semiconductor laser provided in an optical head 13. The tracking control is carried out by detecting a pregroove formed on a disk 10. A feed servo circuit 17 drives a feed motor 20 in response to a command from the system controller 19 to displace the optical head 13 in the radial direction of the disk 10.

[0022] An input signal to be recorded on the optical disk 10 is applied to a data signal forming circuit 22, directly when the signal is a digital signal or through an analog-to-digital converter when the signal is an analog signal, at a speed corresponding to the set recording speed increase ratio. The data signal forming circuit 22 applies interleave to input data to give an error check code to the input data and provides the input data with TOC information and subcoding information generated by a TOC and subcoding generation circuit 23, and EFM modulates the input data to form and output a series of serial data at a transfer rate based on a format of the CD standard and at the set recording speed increase ratio.

[0023] This data is applied through a drive interface 15 to a data signal correction circuit 26 in which the data is subjected to modulation by (n-1) strategy and thereafter is applied to a laser generation circuit 25. The laser generation circuit 25 drives, in response to the data signal, the semiconductor laser in the optical head 13 to project laser beam on the recording surface of the optical disk 10 and thereby record the data by forming pits. The laser power (i.e., pit power and bottom power) during this recording is designated at values corresponding to the recording speed increase ratio according to the invention and is controlled accurately to these designated values by an ALPC (automatic laser power con-

trol) circuit provided in the laser generation circuit 25. By this processing, data is recorded on the optical disk 10 in accordance with the format, transfer speed and linear velocity (1.2 m/s to 1.4 m/s) of the CD standard.

[0024] When the data is reproduced by projecting reproducing laser beam on the optical disk 10 in which the data has been recorded in the above described manner, the read out data is demodulated by a signal reproduction and processing circuit 30 and is delivered out either directly as a digital signal or an analog signal through a digital-to-analog converter 32.

[0025] Fig. 1 is a control block diagram by the optical disk recording and reproducing device of Fig. 4.

[0026] A recording speed increase ratio setting section 28 (the input device 28 of Fig. 4) is operated by a manual operation by an operator or other means to set the recording speed increase ratio. A projection time control section 26 (the data signal correction circuit 26 of Fig. 4) subjects an input EFM signal to modulation by (n-1) strategy and thereby controls the projection time of the laser beam 11. A laser power control section 25 (the laser generation circuit 25 of Fig. 4) changes the pit power in the pit period in accordance with the recording speed increase ratio. More specifically, as the recording speed increase ratio becomes larger, an input heat value per unit length decreases and this makes it difficult to form a pit, so that the pit power is increased to form a proper pit. Simultaneously with the increase in the pit power, the bottom power is also increased to avoid change in difference between the pit power and the bottom power so as to prevent increase in the fall time of the reflected laser beam waveform.

[0027] The laser beam reflected on the optical disk 10 is received by a beam receiving element in the optical head 13 through an objective lens. This received beam signal is supplied to the signal reproducing and processing circuit 30 (Fig. 4) through an RF amplifier 35.

[0028] The tracking error detection circuit 31 detects a tracking error from the received beam signal. The detected tracking error signal is applied to a driver 38 through a sample hold circuit 33 and a filter 36 to drive a tracking actuator in the optical head 13 to perform the tracking control.

[0029] The sample hold circuit 33 passes a tracking error signal in the bottom period excluding the fall period of a reflected waveform and holds and outputs an immediately preceding tracking error signal in the pit period and the fall time Δt. The filter 36 is provided for smoothen a step produced in the tracking error signal at a hold releasing timing. In a playback mode, the sample hold circuit 33 constantly passes a tracking error signal without holding.

[0030] A bandpass filter 40 extracts a wobble signal from the tracking error signal and outputs it. Since the frequency band of the wobble signal varies depending upon the recording speed increase ratio, that is, 22.05 kHz at the normal speed, 44.1 kHz at the double speed and 88.2 kHz at the quadruple speed, the transmission frequency band of the bandpass filter 40 needs to be changed in accordance with the frequency of the wobble signal. For example, the transmission frequency band is set to 10 kHz to 30 kHz at the normal speed and changed to a frequency band having the frequency of the wobble signal as its center frequency as the recording speed increase ratio is changed. An ATip information detection circuit 42 demodulates and outputs ATip information, i.e., time information, which is contained in the form of FM modulated data in the wobble signal.

[0031] A reference frequency generation circuit 44 produces, in response to the set recording speed increase ratio, a reference frequency of the wobble signal, i.e., 22.05 kHz at the normal speed, 44.1 kHz at the double speed and 88.2 kHz at the quadruple speed. A phase comparator 46 compares the phase of the detected wobble signal with the phase of the reference frequency and produces a phase error signal. This phase error signal is smoothed by a low-pass filter 48 and then is applied to a rotation control section 16 (the disk servo circuit 16 of Fig. 4). The rotation control section 16 PLL controls the disk motor 12 so as to bring the phase error to a predetermined value and thereby performs a spindle control of the CLV system.

[0032] An example of the tracking error detection circuit 31 and an example of the sample hold circuit 33 are shown in Fig. 5. A laser beam detector 52 provided in the optical head 13 is made of a four-split PIN photodiode and detects laser beam reflected from the optical disk 10. Detected signals from split sections on the same side of the track of the laser beam detector 52 are combined together and are applied to the tracking error detection circuit 31 and the sample hold circuit 33 through current-voltage converting amplifiers 37 and 39. These signals are applied to a subtractor 58 through analog switches SW1 and SW2, capacitors C1 and C2 and buffer amplifiers 54 and 56 and a difference output from the subtractor 58 is detected as a tracking error signal.

[0033] The analog switches SW1 and SW2 are connected to contacts a during the pit period and the fall time Δt of the relfected beam waveform to provide the detected signal without holding and, accordingly, momently changing tracking error signals are directly provided. The analog switches SW1 and SW2 are connected to contacts b during the bottom period excluding the fall time Δt of the reflected beam waveform. In this case, immediately preceding signals are held by the capacitors C1 and C2 and tracking error signals held at a predetermined value are provided.

[0034] An example of the laser power control by the laser power control section 25 of Fig. 1 is shown in Fig. 6. To a laser diode 60 in the optical head 13 are connected constant current circuits 62, 64 and 84 in parallel and these constant current circuits 62, 64 and 84 are driven by a power source + V. The constant current circuit 62 serves as a playback drive current source and

supplies a drive current I_1 corresponding to reference voltage Vref1 produced by a reference voltage generator 96. The constant current circuit 64 supplies a drive current I_2 corresponding to reference voltage Vref2 produced by a reference voltage generator 98 and constitutes a recording drive current source in combination with the constant current circuit 62. The constant current circuit 84 supplies a drive current I_3 which serves as a compensation current for compensating for a delay portion in rising of the laser power (pit power) when the operation mode of the device is changed from the playback mode to the record mode.

[0035] In the playback mode, the switch 66 is on and the switch 68 is off and the constant current circuit 62 only is in operation so that the laser diode 60 is continuously driven with only the playback drive current I_1. This playback drive current I_1 causes the laser diode 60 to produce a laser beam output of a relatively low power (i.e., the bottom power) which is lower than a threshold value for recording and is sufficient for playback only.

[0036] In the recording mode, the switch 66 is on and the constant current circuit 62 is continuously driven. The switch 68 is also on and the constant current circuit 64 is driven intermittently according to turning on and off of the switch 70 by a signal to be recorded. Therefore, in the recording mode, a signal current of the current value I_2 is superposed on the dc current of the current value I_1 to drive the laser diode 60. The value $I_1 + I_2$ causes the laser diode 60 to produce a laser beam output (pit power) larger than the threshold value for recording and and thereby enables recording on the optical disk 10.

[0037] In the recording mode, the values of the reference voltages Vref1 and Vref2 are changed in accordance with the recording speed increase ratio. In other words, the reference voltage generator 96 increases the value of the reference voltage Vref1 as the recording speed increase ratio increases. This causes both the pit power and the bottom power to be increased with the increase of the recording speed increase ratio. The value of the reference voltage Vref1 is set to values which are sufficiently low to prevent an erroneous forming of a pit in the bottom period at each of the recording speed increase ratios. The reference voltage generator 98 causes the reference voltage Vref2 to be changed in accordance with the recording speed increase ratio to compensate for shortage or surplus in the pit power to provide an optimum pit power at each recording speed increase ratio when increase in the reference voltage Vref1 produces such shortage or surplus.

[0038] In the ALPC circuit, the output of the laser diode 60 is detected by a laser beam detector 72 and applied to error amplifiers 78 and 80 through a converting amplifier 74 and a holding amplifier 76. The error amplifiers 78 and 80 produce errors between the detected laser beam output and the reference voltages Vref1 and Vref2 and cause the constant current values I_1 and I_2 to be changed in accordance with these errors to maintain the laser beam output at a constant value.

[0039] In switching the operation mode from the playback mode to the recording mode for the write-once recording on the disk 10, the compensation current source 84 is driven for compensating for the delay in rising of the laser beam output immediately after switching of the operation mode. The compensation current source 84 supplies to the diode 60 a current value corresponding to difference between the current value of the constant current circuit 64 and a predetermined drive current reference value as the current I_3.

[0040] The operation of the circuit of Fig. 6 is shown in Figs. 7A to 7C. When it is desired to carry out the write-once recording, the laser diode 60 is initially driven in the playback mode (0.7 mW in this example) to feed the optical head 13 radially outwardly from the innermost position for conducting a search for an end point of a recorded portion. Upon detecting a track in which the end point of the recorded portion exists, a pause state is brought about (i.e., the same track is traced). Then, drive of the laser diode 60 is changed to the recording mode at a timing of passing the end point of the recorded portion for switching the operation mode to the recording mode to start recording.

[0041] In the example of Fig. 7, the pit power and the bottom power are changed in the following manner in accordance with the recording speed increase ratio.

	pit power	bottom power
Normal speed	6.5	0.7
double speed	9.0	1.0
quadruple speed	13.0	1.4

[0042] According to this change of the laser power, not only the pit power but also the bottom power are increased as the recording speed increase ratio increases and, therefore, difference between the pit power and the bottom power is reduced as compared with a case where the pit power only is increased. Accordingly, the fall time Δt of the reflected beam waveform undergoes little change and an adequate period of time is available for detecting a tracking error even at a high recording speed increase ratio. This ensures an excellent signal-to-noise ratio in the wobble signal. Further, since the bottom power is increased, a sharp leading edge of the pit power for a next pit period can be obtained with resulting reduction in the delay in the pit start position.

[0043] A specific example of the circuit of Fig. 6 is shown in Fig. 8. A signal to be recorded is applied to one transistor 88 which constitutes a differential amplifier 86 with another transistor 90. A laser diode 60 is inserted on the collector side of the other transistor 90 and is driven in response to the signal to be recorded.

[0044] Two constant current circuits consisting of tran-

sistors 64 and 84 are connected to a common emitter of the differential amplifier 86. To the cathode of the laser diode 60 is connected a constant current circuit consisting of a transistor 60 through an inductance 83. This inductance 83 is provided for preventing an undesirable influence by the switching operation current on the side of the differential amplifier 86 on the constant current circuit consisting of the transistor 62.

[0045] Among these constant current circuits, the transistor 62 supplies the playback drive current I_1, the transistor 64 the current I_2 in the recording drive current $I_1 + I_2$ and the transistor 84 the compensation current I_3. An integration type loop filter 82 is inserted in a control path of the drive current I_2 and the compensation current I_3 is controlled by the output of this loop filter 82. The loop filter 82 is provided for stabilizing the ALPC loop characteristics and preventing possible flow of rush current to the laser diode 60 and resulting damage to the laser diode 60 or shortening of its life in the case of unexpected conduction of the switch 68.

[0046] This loop filter 82 caused a delay in rising of the drive current I_2 in switching from the playback mode to the recording mode. Since, however, the output of the loop filter 82 is applied to a subtractor 94 which receives also a mode switching signal as a reference signal, the transistor 84 is controlled by a difference output from the subtractor 94 to supply the compensation current I_3 and, therefore, the delay in rising of the drive current I_2 is corrected.

[0047] In the above described embodiment, recording is made on the basis of the CD-WO standard. This invention however is applicable to recording on an optical disk on the basis of other standards.

[0048] In the above described embodiment, recording is made on a dye type optical disk. The invention however is applicable to various other types of optical disks including a metal type optical disk.

[0049] In the above described embodiment, the tracking error detection is made in the bottom period. The invention is applicable also to an optical disk recording device in which the tracking error detection in the bottom period is not made. In this case, the advantageous result that a sharp leading edge in the pit power for a next pit period is obtained with resulting reduction in the delay in the pit start position can still be obtained.

[0050] In the above described embodiment, the pit level and the bottom level are increased over the entire pit period and bottom period. Alternatively, the pit level and/or the bottom level may be increased in only a part of the pit period and/or the bottom period. For example, if the laser power in a former half of the bottom period is increased, the trailing edge of the reflected laser beam waveform will be shortened and, if the laser power in a latter half of the bottom period is increased, the leading edge of the pit power in a next pit period will become sharpened.

[0051] In the above described embodiment, no particular consideration has been given to the linear velocity. A control may additionally be made so that the pit power and the bottom power will be changed in accordance with the linear velocity (1.2 m/s to 1.4 m/s in the CD-WO standard), i.e., the pit power and the bottom power will be increased as the linear velocity is increased.

Claims

1. An optical disk recording device for froming a pit or mark on an optical disk (10) by projecting a recording laser beam (11) onto said disk, for an amount of time corresponding to a length of the pit or the mark to be formed comprising:

   recording speed setting means (28) for setting a recording speed;
   rotation control means (16) for rotating the optical disk at a recording speed set by the recording speed setting means:
   laser power control means (25) for controlling the laser power of the recording laser beam in a pit or marking period and the laser power of the recording laser beam in a bottom or non-marking period in such a manner that both the laser power in at least a part of the pit or marking period and the laser power in at least a part of the bottom or non-marking period will be increased as the set recording speed is increased;
   tracking error detection means (31) for detecting a tracking error from the laser beam reflected during the bottom or non-marking period, of the recording mode and producing a tracking error signal during the recording mode.

2. An optical disk recording device as defined in claim 1 further comprising: tracking error signal holding means (33) for passing the tracking error signal in a bottom or non-marking period excluding a fall time of the reflected laser beam and holding and outputting an immediately preceding tracking error signal in a pit or marking period and the fall time of the reflected laser beam.

3. An optical disk recording device as defined in claim 1 or 2 which further comprises playback means (35) and laser power generation means, said laser power control means comprising:

   first reference voltage generation means (96) for generating a first reference voltage which is increased with the increase in the recording speed;
   playback current supply means (62) responsive to the first reference voltage (96) for supplying a drive current for playback which causes the laser power generation means to produce a

laser power in the pit or marking period which is smaller than a threshold value for recording:

second reference voltage generation means (98) for generating a second reference voltage; and

recording current supply means (64) responsive to the first and second reference voltages for supplying a drive current for recording which causes the laser power generation means to produce a laser power in the pit or marking period which is larger than the threshold value for recording.

4. An optical disk recording device as defined in claim 3 further comprising:

compensation current supply means (84) for supplying a drive current to the laser power generation means for compensating for a delay in rising of the laser power caused in switching an operation mode of the optical disk recording device from a playback mode to a recording mode.

5. An optical disk recording device as defined in anyone of claims 1-4 wherein recording is made on the basis of CD-WO standard.

Patentansprüche

1. Aufzeichnungsvorrichtung für eine optische Platte zum Formen einer Vertiefung oder Markierung auf einer optischen Platte (110) durch das Projizieren eines Aufzeichnungslaserstrahls auf die Platte, und zwar für einen Zeitraum, der der Vertiefungslänge der zu formenden Vertiefung entspricht, die folgendes aufweist:

Aufzeichnungsgeschwindigkeit-Einstellungsmittel (28), um eine Aufzeichnungsgeschwindigkeit einzustellen;

Rotationssteuerungsmittel (16) zur Rotation der optischen Platte mit einer Aufzeichnungsgeschwindigkeit, die durch die Aufzeichnungsgeschwindigkeits-Einstellungsmittel eingestellt ist;

Laserleistungssteuerungsmittel bzw. Laserleistungsregelungsmittel (25) zur Steuerung bzw. Regelung der Laserleistung eines Aufzeichnungslaserstrahls in einer Vertiefungs- oder Markierungsperiode und der Laserleistung eines Aufzeichnungslaserstrahls in einer Boden- oder Nichtmarkierungseriode, und zwar auf so eine Art und Weise, daß beide, die Laserleistung in zumindest einem Teil der Vertiefungs- oder Markierungsperiode und die Laserleistung in zumindest einem Teil der Boden- oder Nichtmarkierungsperiode erhöht wird, wenn die eingestellte Aufzeichnungsgeschwindigkeit erhöht wird;

Spureinstellungsfehler-Erfassungsmittel (31) zum Erfassen von Spureinstellungsfehlern von dem während der Bodenperiode des Aufzeichnungsmoduses reflektierten Laserstrahls und zur Erzeugung eines Spureinstellungsfehlersignals während des Aufzeichnungsmoduses.

2. Aufzeichnungsvorrichtung für eine optische Platte nach Anspruch 1, die weiterhin aufweist:

Spureinstellungsfehlersignal-Speichermittel (33) zur Weitergabe des Spurenstellungsfehlersignals in einer Boden- oder Nichtmarkierungsperiode ausschließlich einer Abfallzeit des reflektierten Laserstrahls und zum Speichern und zum Ausgeben eines unmittelbar vorhergehenden Spureinstellungsfehlersignals in einer Vertiefungs- oder Markierungsperiode und der Abfallzeit des reflektierten Laserstrahls.

3. Aufzeichnungsvorrichtung für eine optische Platte nach Anspruch 1 oder 2, welche weiterhin Wiedergabemittel (35) und Laserleistungssteuerungsmittel bzw. Laserleistungsregelungsmittel aufweist, die Laserleistungssteuerungsmittel aufweisen:

erste Referenzspannungserzeugungsmittel (96) zur Erzeugung einer ersten Referenzspannung, welche erhöht wird mit der Erhöhung der Aufzeichnungsgeschwindigkeit;

Wiedergabestromversorgungsmittel (62), die, ansprechend auf die erste Referenzspannung (96), einen Antriebsstrom liefert zur Wiedergabe, die die Laserleistungserzeugungsmittel veranlassen, eine Laserleistung in der Vertiefung oder Markierungsperiode zu erzeugen, die geringer ist als ein Schwellenwert für die Aufzeichnung;

zweite Referenzspannungserzeugungsmittel (98) zur Erzeugung einer zweiten Referenzspannung; und

Aufzeichnungsstromversorgungsmittel (64), die, ansprechend auf die erste und zweite Referenzspannung, einen Antriebsstrom liefert zur Aufzeichnung, welcher die Laserleistungserzeugungsmittel veranlaßt, eine Laserleistung in der Vertiefungs- oder Markierungsperiode zu produzieren, welche größer ist als der Schwellenwert zum Aufzeichnen.

4. Aufzeichnungsvorrichtung für eine optische Platte nach Anspruch 3, die weiterhin aufweist:

Kompensationsstromversorgungsmittel (84) zum Liefern eines Antriebsstroms an die Laser-

leistungserzeugungsmittel zum Kompensieren einer Verzögerung im Ansteigen der Laserleistung, verursacht durch das Umschalten des Betriebsmodus der Aufzeichnungsvorrichtung für eine optische Platte von einem Wiedergabemodus in einen Aufzeichnungsmodus.

5. Aufzeichnungsvorrichtung für eine optische Platte nach einem der vorherigen Ansprüche 1 bis 4, wobei das Aufzeichnen auf der Basis des CD-WO Standards erfolgt.

Revendications

1. Dispositif d'enregistrement de disque optique pour former une cavité ou un marquage sur un disque optique (10) en projetant un faisceau laser d'enregistrement (11) sur le disque pendant une durée qui correspond à la longueur de la cavité ou du marquage à former, comprenant :

   un moyen de réglage de vitesse d'enregistrement (28) pour fixer une vitesse d'enregistrement ;
   un moyen de commande de rotation (16) pour faire tourner le disque optique à une vitesse d'enregistrement fixée par le moyen de réglage de vitesse d'enregistrement ;
   un moyen de commande de puissance du laser (25) pour commander la puissance du faisceau laser d'enregistrement pendant la durée de cavité ou de marquage et la puissance du faisceau laser d'enregistrement pendant une durée de fond ou de non marquage de sorte que la puissance laser pendant au moins une partie de la durée de cavité ou de marquage et la puissance laser pendant au moins une partie de la durée de fond ou de non marquage est augmentée tandis que la vitesse d'enregistrement fixée est augmentée ;
   un moyen de détection d'erreur de poursuite (31) pour détecter une erreur de poursuite à partir du faisceau laser réfléchi pendant la durée de fond du mode d'enregistrement et pour produire un signal d'erreur de poursuite pendant le mode d'enregistrement.

2. Dispositif d'enregistrement de disque optique selon la revendication 1, comprenant en outre un moyen de maintien de signal d'erreur de poursuite (33) pour faire passer le signal d'erreur de poursuite dans une durée de fond ou de non-marquage excluant une durée de décroissance du faisceau laser réfléchi et pour maintenir et fournir le signal d'erreur de poursuite immédiatement précédent pendant une durée de cavité ou de marquage et la durée de décroissance du faisceau laser réfléchi.

3. Dispositif d'enregistrement de disque optique selon la revendication 1 ou 2, comprenant en outre un moyen (35) de reproduction et un moyen de génération de puissance laser, le moyen de commande de puissance laser comprenant :

   un premier moyen de génération de tension de référence (96) pour fournir une première tension de référence qui est augmentée avec une augmentation de vitesse d'enregistrement ;
   un moyen de fourniture de courant de reproduction (62) agissant en réponse à la première tension de référence (96) pour fournir un courant de commande de reproduction qui amène le moyen de génération de puissance laser à produire une puissance laser pendant la durée de cavité ou de marquage qui est inférieure à une valeur de seuil d'enregistrement ;
   un second moyen de génération de tension de référence (98) pour produire une seconde tension de référence ; et
   un moyen de fourniture de courant d'enregistrement (64) en réponse aux première et seconde tensions de référence pour fournir un courant de commande d'enregistrement qui amène le moyen de génération de puissance laser à produire une puissance laser pendant la durée de la cavité ou du marquage qui est supérieure à la valeur de seuil d'enregistrement.

4. Dispositif d'enregistrement à disque optique selon la revendication 3, comprenant en outre :

   un moyen de fourniture de courant de compensation (84) pour fournir un courant de commande au moyen de génération de puissance laser pour compenser un retard de montée de puissance laser lors de la commutation d'un mode de fonctionnement du dispositif d'enregistrement à disque optique d'un mode de reproduction à un mode d'enregistrement.

5. Dispositif d'enregistrement de disque optique selon l'une quelconque des revendications 1 à 4, dans lequel l'enregistrement est effectué sur la base d'un standard CD-WO.

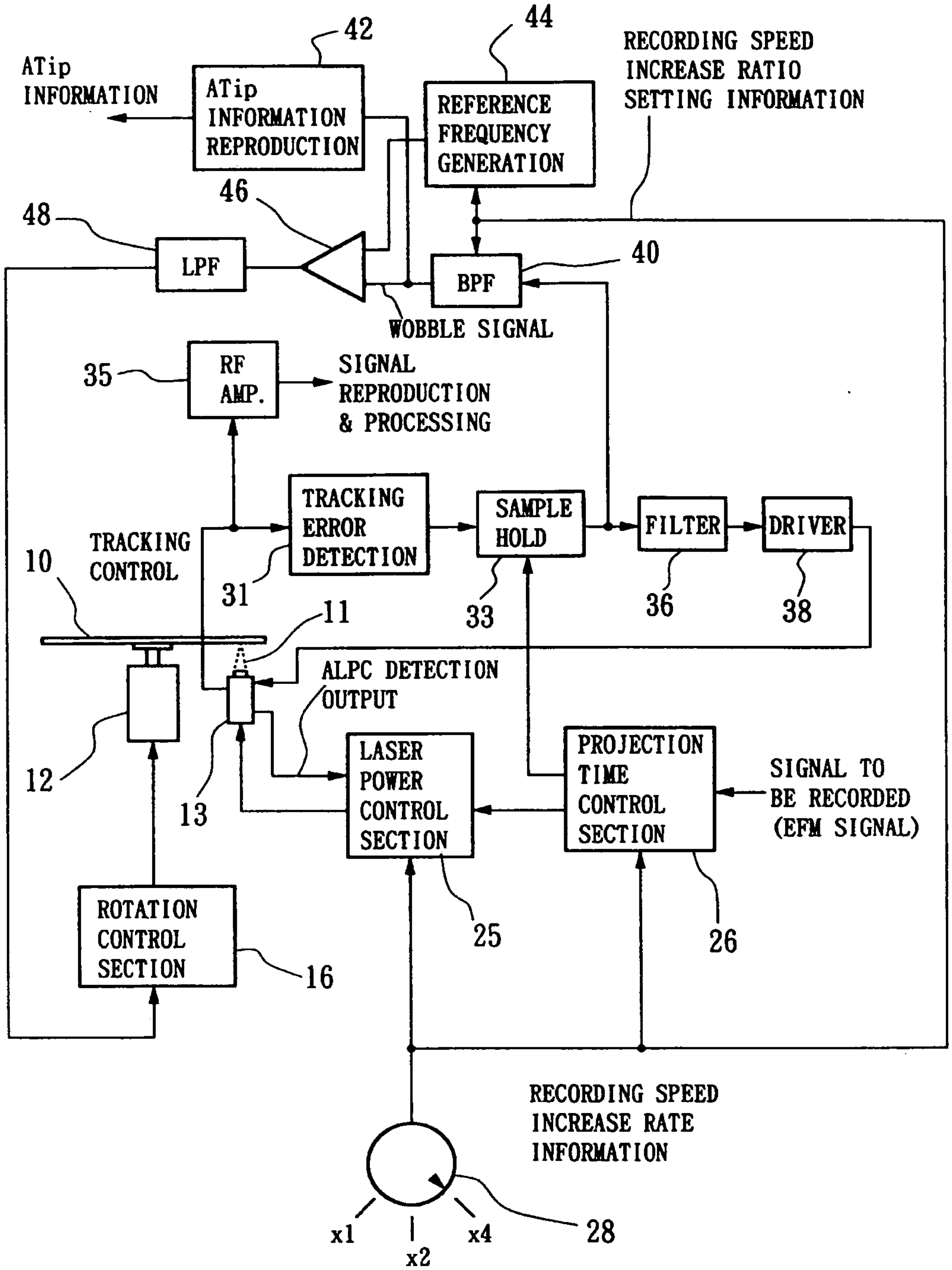

ATip INFORMATION
ATip INFORMATION REPRODUCTION
42
44
REFERENCE FREQUENCY GENERATION
RECORDING SPEED INCREASE RATIO SETTING INFORMATION
46
48
LPF
BPF
40
WOBBLE SIGNAL
35
RF AMP.
SIGNAL REPRODUCTION & PROCESSING
TRACKING ERROR DETECTION
SAMPLE HOLD
FILTER
DRIVER
TRACKING CONTROL
10
31
33
36
38
11
ALPC DETECTION OUTPUT
12
13
LASER POWER CONTROL SECTION
PROJECTION TIME CONTROL SECTION
SIGNAL TO BE RECORDED (EFM SIGNAL)
ROTATION CONTROL SECTION
16
25
26
RECORDING SPEED INCREASE RATE INFORMATION
x1
x2
x4
28

FIG. 1

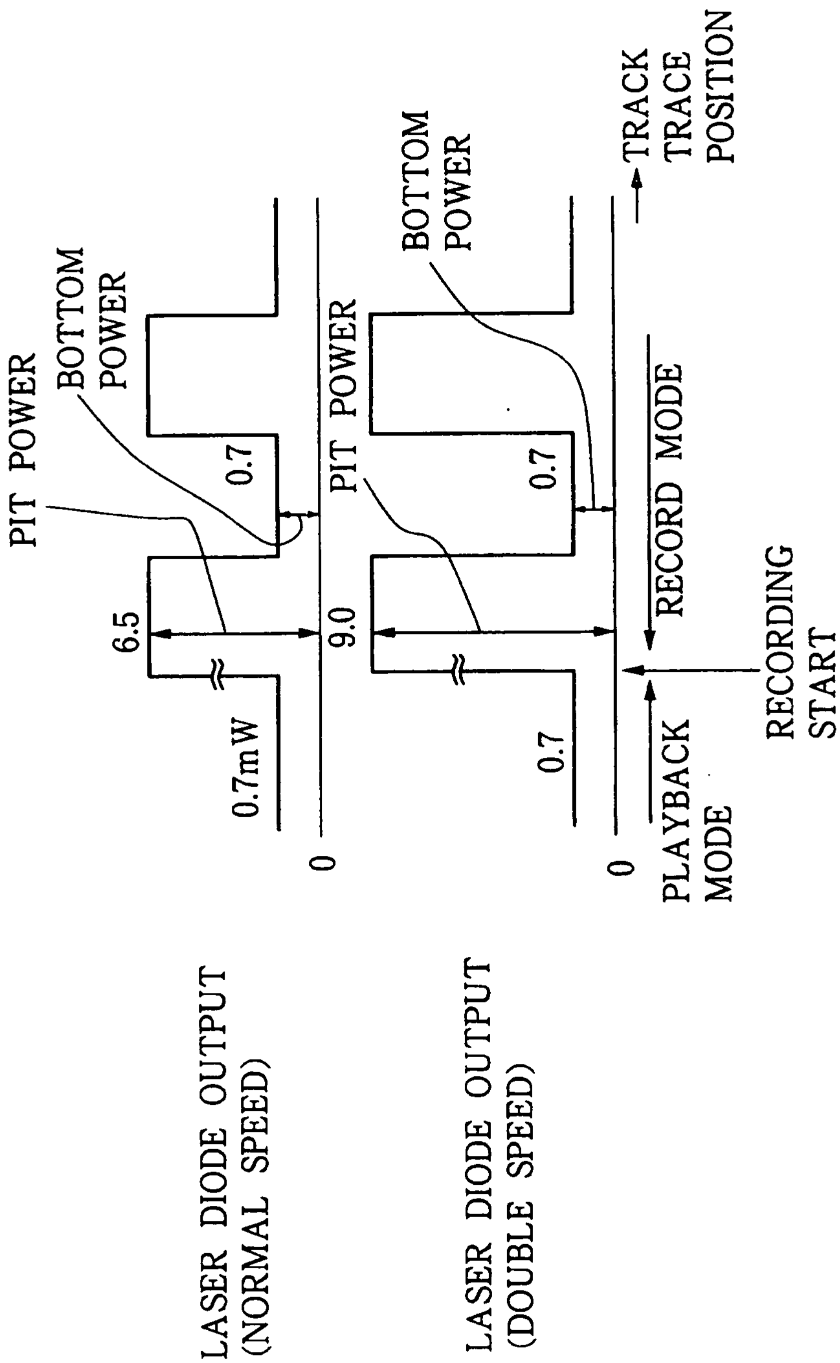


FIG. 2
PRIOR ART

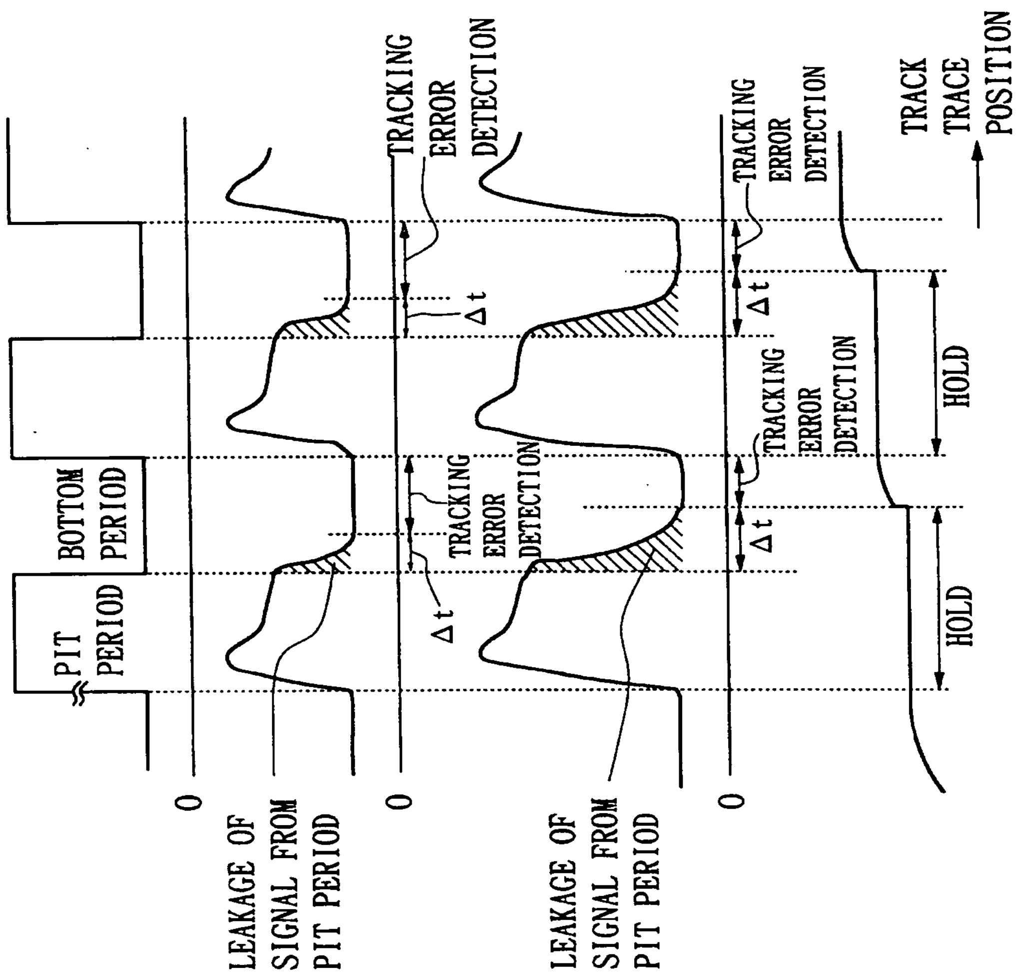


FIG. 3A LASER DIODE OUTPUT

FIG. 3B REFLECTED LASER BEAM WAVEFORM (NORMAL SPEED)

FIG. 3C REFLECTED LASER BEAM WAVEFORM (DOUBLE SPEED)

FIG. 3D TRACKING ERROR SIGNAL

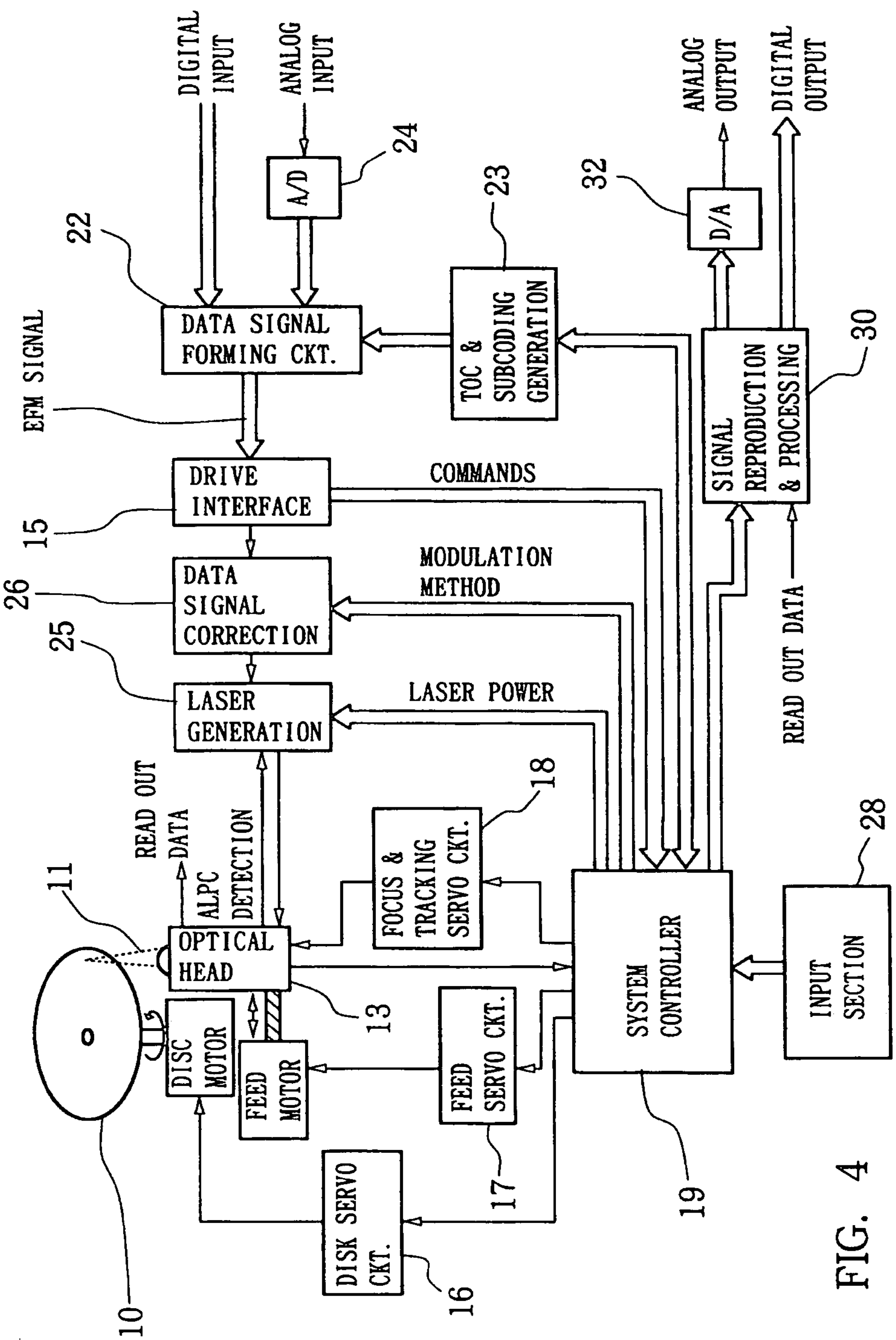

DIGITAL INPUT
ANALOG INPUT
A/D
24
22
DATA SIGNAL FORMING CKT.
TOC & SUBCODING GENERATION
23
32
D/A
ANALOG OUTPUT
DIGITAL OUTPUT
EFM SIGNAL
DRIVE INTERFACE
15
COMMANDS
SIGNAL REPRODUCTION & PROCESSING
30
DATA SIGNAL CORRECTION
26
MODULATION METHOD
25
LASER GENERATION
LASER POWER
READ OUT DATA
READ OUT DATA
ALPC DETECTION
11
OPTICAL HEAD
FOCUS & TRACKING SERVO CKT.
18
SYSTEM CONTROLLER
INPUT SECTION
28
DISC MOTOR
FEED MOTOR
13
FEED SERVO CKT.
17
19
DISK SERVO CKT.
16
10

FIG. 4

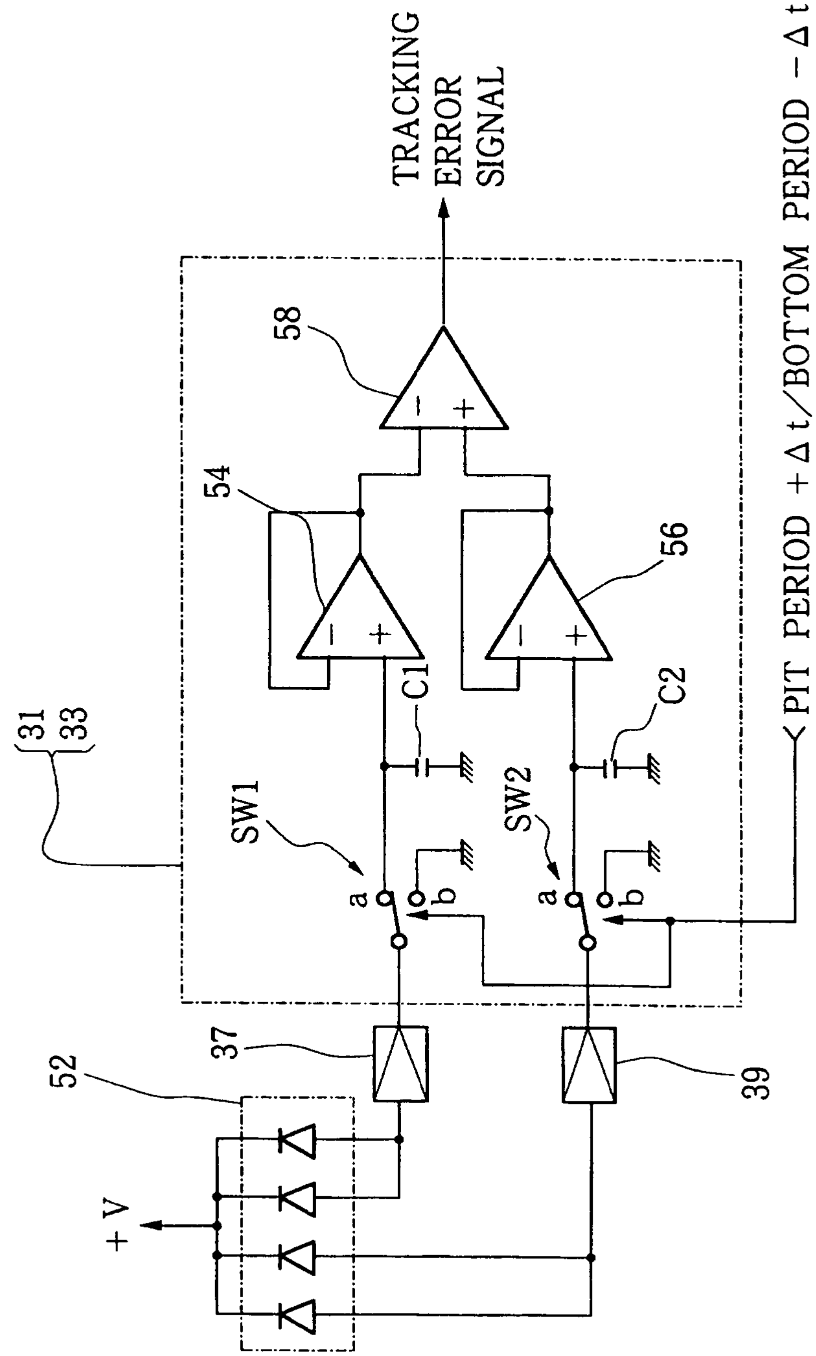
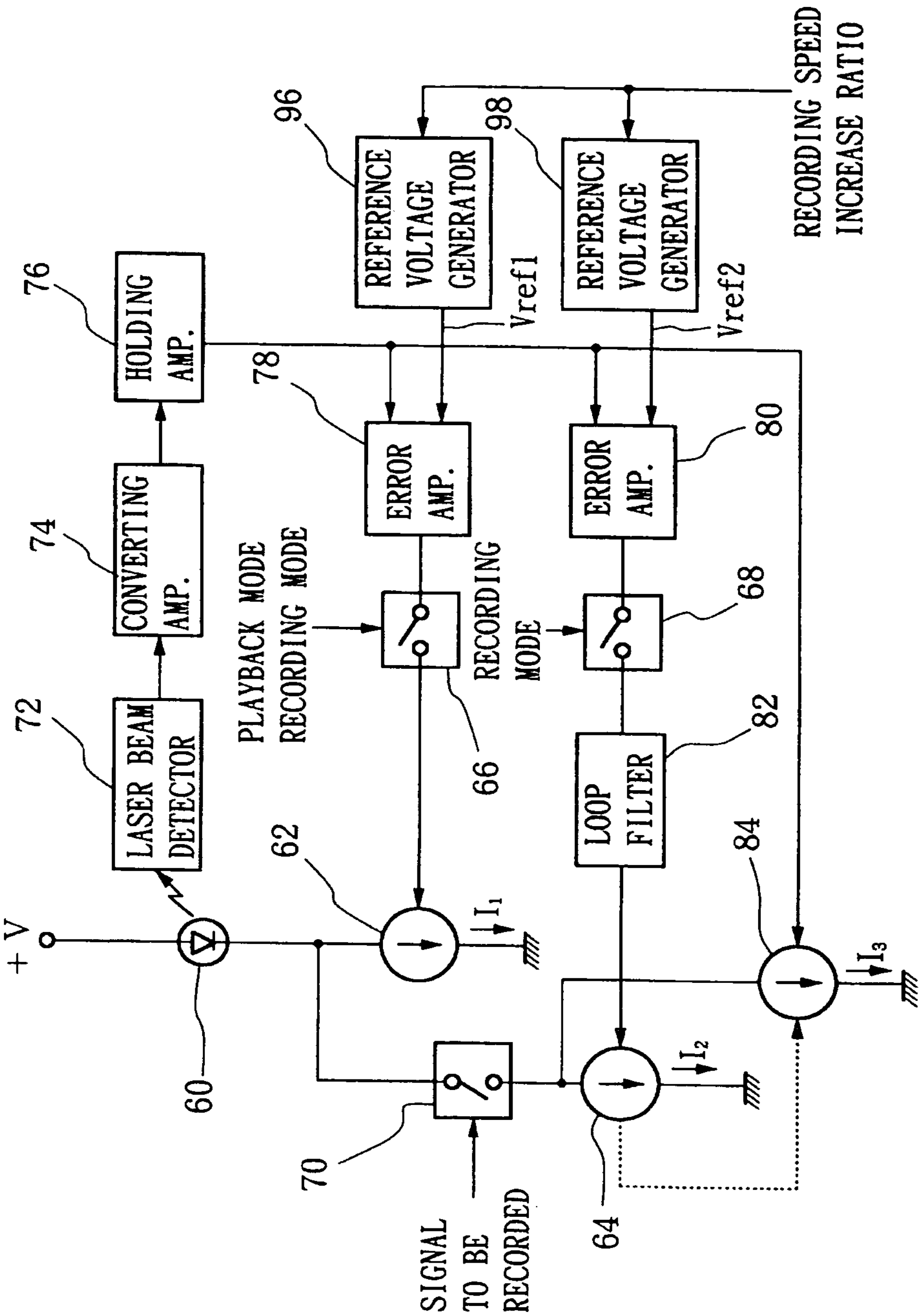

TRACKING
ERROR
SIGNAL
58
54
56
31
33
C1
C2
SW1
SW2
a
b
a
b
52
37
39
+ V
PIT PERIOD + Δ t/BOTTOM PERIOD − Δ t

FIG. 5



+V
60
LASER BEAM DETECTOR
72
CONVERTING AMP.
74
HOLDING AMP.
76
62
I_1
70
SIGNAL TO BE RECORDED
64
I_2
84
I_3
LOOP FILTER
82
PLAYBACK MODE
RECORDING MODE
66
RECORDING MODE
68
ERROR AMP.
78
ERROR AMP.
80
REFERENCE VOLTAGE GENERATOR
96
Vref1
REFERENCE VOLTAGE GENERATOR
98
Vref2
RECORDING SPEED INCREASE RATIO

FIG. 6

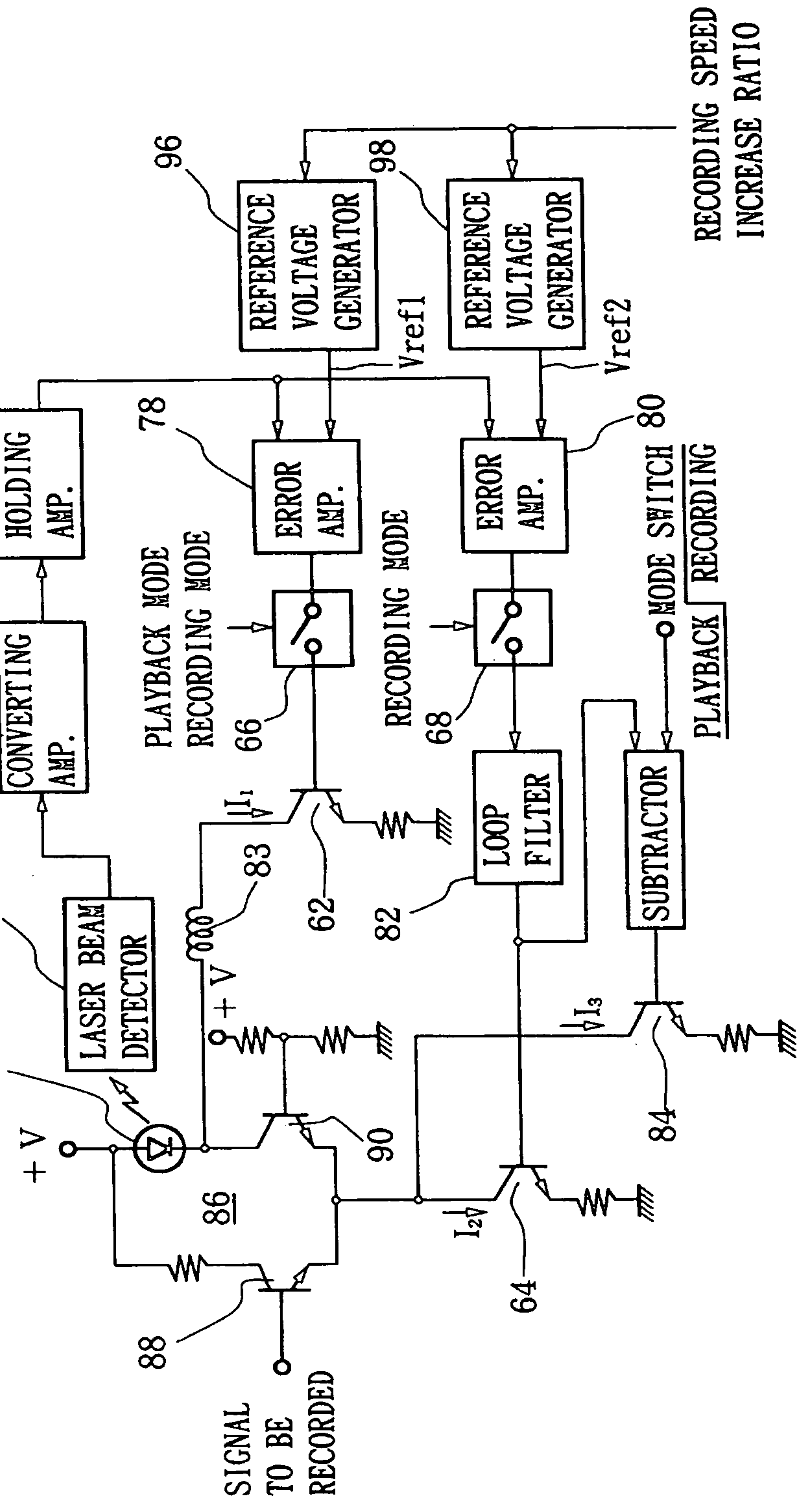

RECORDING SPEED INCREASE RATIO
REFERENCE VOLTAGE GENERATOR
96
REFERENCE VOLTAGE GENERATOR
98
Vref1
Vref2
HOLDING AMP.
76
CONVERTING AMP.
74
LASER BEAM DETECTOR
72
ERROR AMP.
78
ERROR AMP.
80
PLAYBACK MODE
RECORDING MODE
66
RECORDING MODE
68
MODE SWITCH
PLAYBACK
RECORDING
LOOP FILTER
82
SUBTRACTOR
I_1
I_2
I_3
83
62
64
84
90
60
86
88
+ V
+ V
SIGNAL TO BE RECORDED

FIG. 7

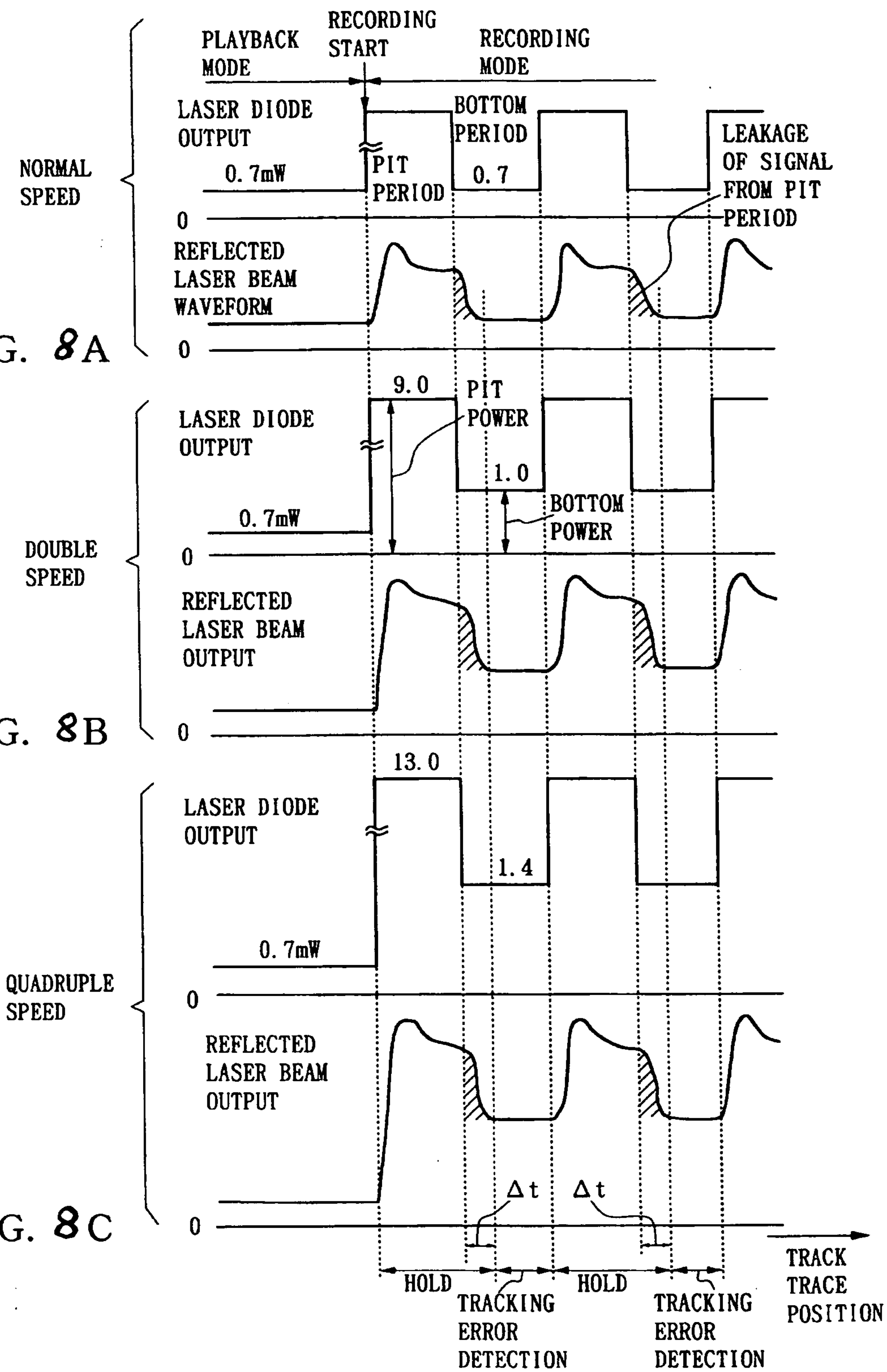


FIG. 8A

FIG. 8B

FIG. 8C